pMTJ Driven STT-MRAM Sampling From 300 mm Process

Avalanche Technology Inc.

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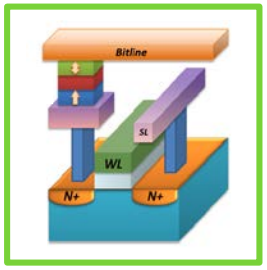
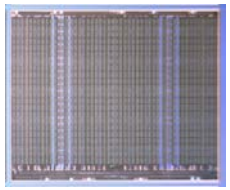
VP of Technology

Avalanche Technology — at a Glance

Avalanche Proprietary STT MRAM Technology



Stand-alone ***SPMEM***™



Avalanche 64 Mb chip

Embedded ***AvRAM***™

Large Markets

Enterprise Storage, Mobile, Telecom & Computing (SAM $15B)

Founded in 2006

Led by an Experienced Team

Industry Veterans Delivering Innovative Storage Solutions

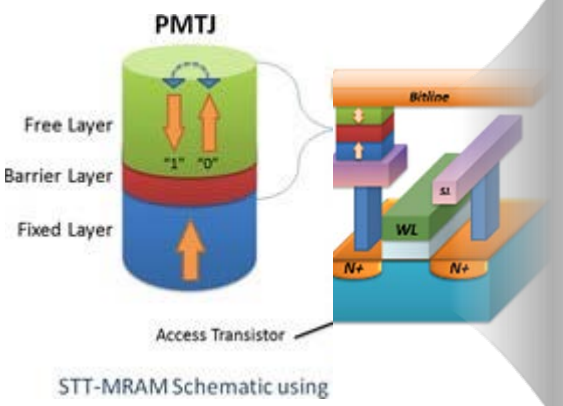
Supported by extensive patent portfolio

240+ patents filed
with 165+ granted /allowed

Backed by Top Tier VCs

THOMVEST VENTURES
BESSEMER VENTURE PARTNERS
sequoia capital
QUALCOMM VENTURES
VULCAN Capital
VTB Capital
Leader Ventures
RVP

AVA pMTJ: Enabling STT MRAM Towards Mainstream Memory



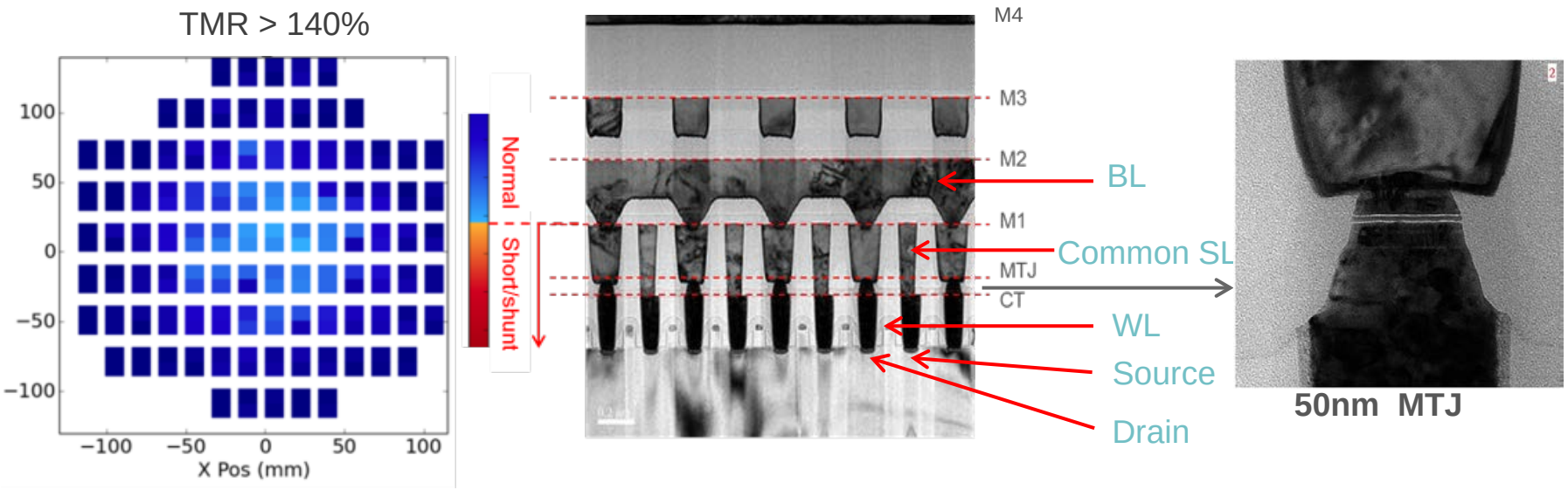
STT-MRAM Schematic using

- Highly scalable to 1x nm: low write current (<100 µA/350mV) with sustainable high thermal stability Δ>80
- Excellent write performance (sub ns and low WER<10^{-8})
- High TMR ~200% (targeting 250 % in near future)
- Thermally stable TMR up to 400 ^{o}C > 60 min.
  → compatible with standard CMOS (embedded)
- High Endurance> 10^{16} cycles
- Excellent Manufacturability (<1x nm): thin stack<200A

AVA pMTJ delivered all attributes required for a disruptive non volatile memory

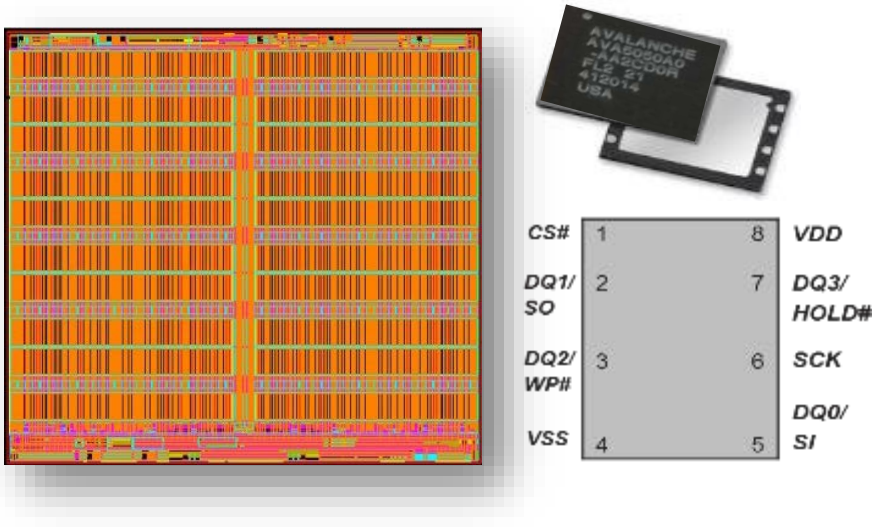
Avalanche Advanced 300 mm BEOL Integration

- Advanced LP CMOS (40-50 nm) in world-class foundry
- Low cost adder with single MTJ etch mask
- Scalable (<1xnm) MTJ BEOL integration process flow (portable to other foundry)
- TMR thermally stable up to 400 ◦C, compatible with embedded applications.
  - **Note – MTJ below M1 as shown. Portable between any 2 metal layers.**



Avalanche Industry's First pMTJ 55nm SPI 64/32 Mb Chip: Customer Sampling Stage

- Write/Read Speed < 50 ns
- BER <10^{-8}



- Data Retention >10 Years
- BEOL: Cu, 4 Metal Layers
- Endurance: ~10^{16}

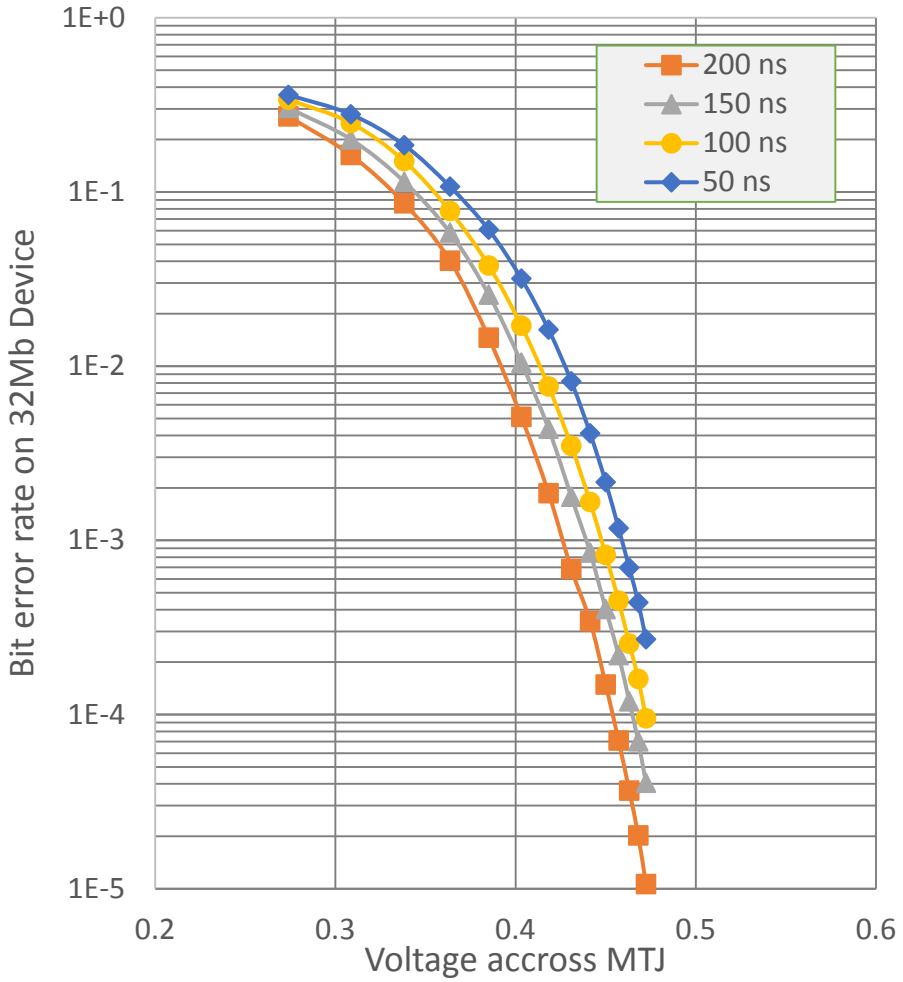
Basic Features:

- Single Power Supply Operation
  - 1.65V – 1.95V Read and Write Operations
- Serial Interface Architecture
  - SPI Compatible: Mode 0 and Mode 3
- 32/64M-bit Density
  - Uniform 256-byte Page
  - Uniform 4K-byte Sector
  - Uniform 64K-byte Block
- Performance Driven: 108MHz Clock Frequency (13.5MB/s)
- Quad Output Fast Read & Quad I/O Fast Read @54MHz Clock Frequency (27MB/s)
- Low Power Consumption
- Package: 8-Pin WSON

64 Mb chip with Industry Standard SPI fabricated with 55 nm LP CMOS at world class foundry

Write Shmoo (No ECC and No Redundancy)

BER plot– 99.99% yield



Avalanche STT-MRAM: Revolutionizing System Design for a Wide Range of Applications

Stand Alone Solutions

- Memory buffers
  - Persistent DRAM
- Battery backup SRAM
- DRAM
- New Market Applications
  - Storage class memory (L4)

Avalanche STT- MRAM

Embedded Solutions

- eNVM
  - eFlash, eOTP, eFuse
- Cache Memory
  - L3, L2..
- eDRAM
- New Market Applications
  - Low standby-power connectivity systems (IoT, wearable electronics)

- **Low power consumption**
- **Low manufacturing cost**

Thank You!

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